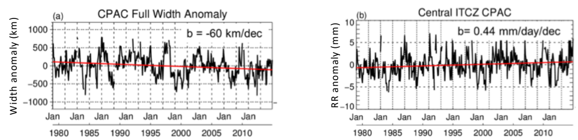
Shifts in deep convection distributions with tropical ascent area changes

Anita D. Rapp and K. Wodzicki
Texas A&M University

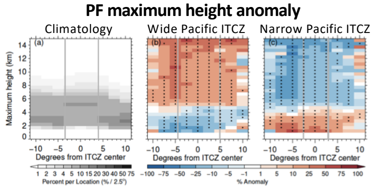
Motivation

- Long-term characterization of the Pacific Intertropical Convergence Zone (ITCZ) shows that the ITCZ has narrowed and precipitation intensity has increased over the last 36+ years

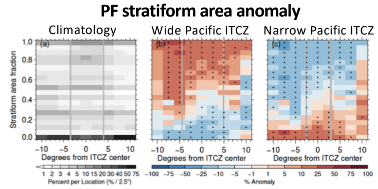


- However, short-term analysis precipitation features (PFs) in the Pacific during the TRMM-era shows that they become more intense and organized when the Pacific ITCZ is wider and weaker when the Pacific ITCZ is narrow
  - Pacific ITCZ width is dominated by ENSO (not shown) leading to an apparent discrepancy between theory and long-term model/observational results that show convection deepens and intensifies as the ascent regions narrow

PF maximum height anomaly



PF stratiform area anomaly



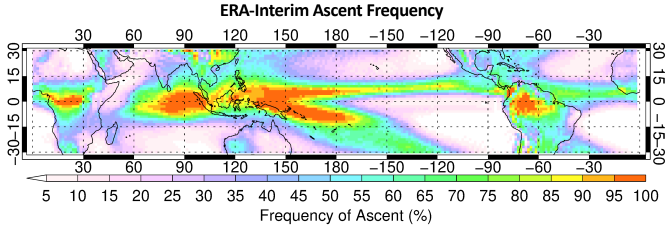
THIS RESEARCH:

→ ***To overcome this dichotomy between short-term Pacific and long-term model/observational results, here we analyze the relationship between total tropical ascent area and TRMM PF characteristics***

Data & Methods

- ERA-Interim used to determine grid boxes with monthly mean ascent where $\omega_{500} < 0.0$
- Tropical ascent area fraction (*Au*) computed as fractional area between 30°S-30°N that contains ascent

ERA-Interim Ascent Frequency



- The distribution of post-boost TRMM PR PFs (Liu et al. 2008) within ascent regions identified for every month
- The relationship between *Au* and PF maximum height, area, stratiform area, and rain rates for the top 5% of deep convection distributions are analyzed

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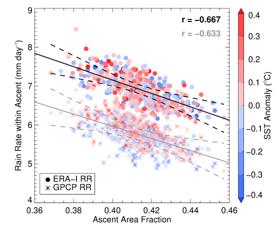
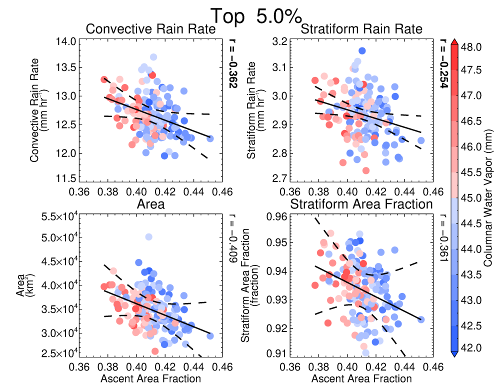
Results

Ascent Area vs. Grid Box Mean Rain Rate

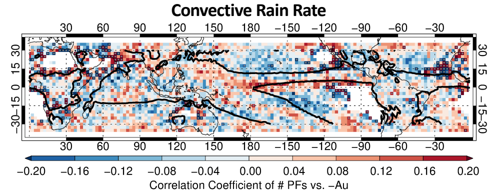


Ascent Area vs. PF Characteristics

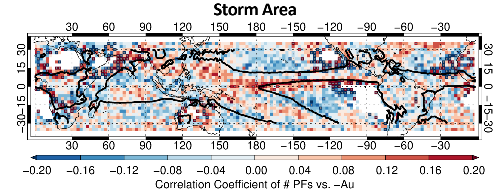


- Rain rate increases in the ascent area as tropical *Au* decreases
- Negative correlations between ascent area and PF characteristics
  - The top 5% of rain rate, area, and stratiform fraction all increase as Au decreases
  - Strong relationship between *Au* and CWV in ascent regions
- PF correlations with –*Au* show large regional variability, but intensification with narrowing primarily on the Pacific southern ITCZ edge, parts of the warm pool, and Atlantic ITCZ

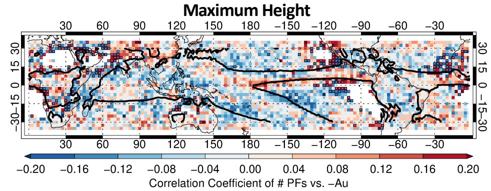
Convective Rain Rate



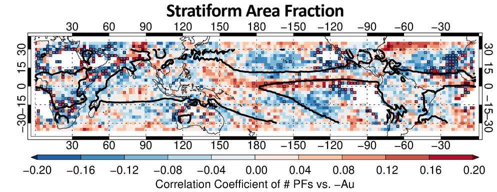
Storm Area



Maximum Height



Stratiform Area Fraction



Summary

- Tropics-wide, as ascent area shrinks, moisture in ascent regions increases and the top 5% of PFs:
  - increase rain rate (in both convective and stratiform regions)
  - are larger
  - have greater stratiform fractions

→Indicates a shift toward larger, more organized convective systems as ascent area decreases and moisture increases
  ? Evidence of convective aggregation in moist regions

Papers:

Wodzicki, K., and A.D. Rapp, 2020: Variations in Precipitating Convective Feature Populations with ITCZ Width in the Pacific Ocean. *J. Climate*, **33** (10), 4391–4401. https://doi.org/10.1175/JCLI-D-19-0689.1